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Interactive Comment

Interactive comment on "Investigation of the effective peak supersaturation for liquid-phase clouds at the high-alpine site Jungfraujoch, Switzerland (3580 m a.s.l.)" *by* E. Hammer et al.

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The authors would like to thank F. Ditas for the helpful and well thought comments and suggestions. All comments of the short comment of F. Ditas are addressed below. The reviewer's comments are in italics and our responses in plain text.

General comments:

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Interactive Discussion
Discussion Paper

This is a very good paper on the analysis of the aerosol microphysical and hygroscopic properties of the interstitial and total aerosol particles at the high-alpine station Jungfraujoch. The authors derived the activated fraction, activation diameter and estimated the effective peak supersaturation at cloud base.

I have some minor comments on the paper. Unfortunately, there are no measurements at cloud base. The authors use therefore the liquid water content to calculate the temperature at cloud base height assuming adiabaticity. They argue, that a relative error of 15 % of the LWC measurements causes a relative error of T_{CB} *of 0.2* K*. Nevertheless, due to entrainment and mixing the LWC may deviate from the adiabatic LWC by more than 15 % resulting in a larger error in* T_{CB}*.*

We agree that entrainment complicates the calculation of the temperature at the cloud base. That's why we filtered out all the data periods showing an activation plateau below 0.9 (see Fig. 3b), which is an indicator for substantial entrainment or mixed-phase clouds. Therefore, we can neglect any issues resulting from entrainment and/or mixed-phase clouds. Summarizing, no data that may have been influenced by entrainment, or the presence of ice, has been included in the paper.

Finally, the authors present the derived effective peak supersaturation together with their estimates about the vertical wind velocity. In Fig. 9 these findings are compared to box model calculations. For NW conditions the model overpredicts the observed supersaturation values. The authors speculate that either the cloud base updraft velocity is overestimated or vertical wind velocity fluctuations are responsible for this mismatch. To my eyes, especially the observations for the NW conditions agree well with the model calculations. The model calculations seem to represent an upper limit for the possible effective peak supersaturation resulting from the corresponding vertical wind velocity for adiabatic conditions. The deviations towards lower supersaturation values could probably be caused by entrainment and mixing, resulting in the evaporation of

ACPD

13, C9435–C9438, 2013

cloud droplets. Hence, the activated fraction decreases and the activation diameter increases, leading to a lower effective peak supersaturation. In general, I would not expect a perfect agreement.

We agree that entrainment reduces the activated fraction. However, only a negligible effect on the half-rise activation diameter and consequently on the inferred effective peak supersaturation is expected. Anyway, entrainment can be excluded as a main reason for the differences between observed and modeled peak supersaturations as cloud periods with substantial entrainment have been filtered, as stated above. We made this point clearer in the revised version of our manuscript in section 3.1: “Any events with an activation plateau significantly below unity were filtered in order to remove mixed-phase clouds and clouds with substantial entrainment.”

And added in sect. 4.5.2: “entrainment of dry air can be excluded based on the cloud event filtering discussed in sect. 3.1”

In the introduction, the authors present a nice overview about previous measurements inside clouds and the derivation of activation diameter and supersaturation. In this context and in Tab. 3 following publication can give further information: Ditas, F., Shaw, R. A., Siebert, H., Simmel, M., Wehner, B., and Wiedensohler, A.: Aerosols-cloud microphysics-thermodynamics-turbulence: evaluating supersaturation in a marine stratocumulus cloud, Atmos. Chem. Phys., 12, 2459-2468, doi:10.5194/acp-12-2459-2012, 2012.

Indeed, this publication fits very well into our introduction and we will include it in the revised manuscript: “Only few studies determined SS_{peak} in ambient clouds experimentally using dry particle size distributions and their hygroscopic properties (e.g. Anttila

ACPD

13, C9435–C9438, 2013

et al., 2009; Asmi et al., 2012, Ditas et al., 2012)."

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13, C9435–C9438, 2013